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DRAWINGS ATTACHED

1 340 581

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(54) IMPROVEMENTS RELATING TO PACKAGING MACHINES

(71) We, BRITISH AMERICAN TOBACCO COMPANY LIMITED, a Company incorporated under the laws of Great Britain, of Westminster House, 7 Millbank, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in packaging machines, especially to machines for assembling packages in the form of so-called "double-shell" packs the contents of which can be single objects or a group of objects which may be for example rod-like such as cigarettes or the like inserted into a preformed hollow rectangular tube, the "inner shell", this rectangular inner tube or shell together with its enclosed contents, then being inserted into another hollow rectangular tube, the "outer shell' and thus forming a complete package.

According to the invention, there is provided a packaging machine for producing a package comprising an inner shell containing the contents of the package and an outer shell which contains the inner shell, said machine including a first, vertical magazine containing inner shells and a second vertical magazine containing outer shells, control means by which all the movements imparted to the individual parts of the package and to the assembled package are controlled, means for extracting the inner and outer shells from the lower end of each magazine, means for feeding the contents of the package into the inner shell, means for moving the inner shell and contents into the outer shell and means for conveying the assembled package to a further package handling station.

In a particular embodiment of the invention, all the movements imparted to the individual parts of the package and the assembled package by the control means are effected by means operating rectilinearly, and are preferably produced by using pneumatically operated cylinders with pistons which are automatically controlled by a mechanism employing fluidic logic circuits. Such a machine is particularly suitable for use with a conventional pre-packing machine.

One embodiment of the invention will now be described by way of an example and with reference to the accompanying drawings, in which for the purpose of the ensuing description inessential parts have been omitted for clarity.

In the drawings:

Figure 1 illustrates the basic sequence of the packaging operation;

Figure 2(*a*) to 2(*d*) illustrate the shell opening and erecting sequence;

Figure 3 is a schematic plan view of the packaging machine below the outlets of the shell magazines;

Figure 4 is a side elevation showing the insertion of the package contents into the inner shell;

Figures 5 and 6 are perspective diagrams of the package orienting arrangement;

Figure 7 is a perspective diagram showing the discharge of a package from the orienting arrangement;

Figures 8*a* and 8*b* illustrate a back pressure jet;

Figures 9*a* and 9*b* are diagrams of a turbulence amplifier; and

Figure 10 illustrates the means which guide one part of the package into another.

As shown in Figure 1, a typical pack consists of two rectangular tubes. The tubes or shells are made on special machinery, being creased at the corners and supplied to the user in a flattened state.

The inner shell 1 has to be "erected" i.e. changed from its flattened state to a rectangular open tube before the product 2 can be slid into the inner shell.

The outer shell 3 is also supplied in a flattened state. It also has to be "erected" and then the inner shell 1, complete with

contents 2 (the product) is slid into it and Figure 1 illustrates schematically the sequence of these operations.

The flattened shells 1 and 3 are loaded into magazines or hoppers 4 (Figure 2) which deliver the shells 1 and 3 to the machine and preferably the hoppers 4 for the flattened shells are made from a transparent plastics material for visibility and lightness and they may be adjustable for shell size, within limits. Ideally they are separate components, being attached to the baseplate for example by quick-release toggle clamps and located by dowels. This quick-release facility greatly assists clearing a jam if it occurs or the changing one type of shell for another.

The flattened shells 1, 3 are placed in their respective magazines or hoppers 4, as shown in Figure 2*a*, and also as shown in Figure 2*a* are supported by four lipped plate springs 5 allowing sufficient space for the removal from the stack and opening and erection of the bottom shell. Situated above the lipped plate springs 5 are two tapered pieces 6, which narrow the width of the hopper, thus making the shells stack at an angle to the horizontal.

When leaving the tapered pieces 6 the lower shells 1, 3 separate on one side as shown in Figure 2*a*. This as shown in Figure 2*b* is to allow space for a slight buckling of the shell which is being withdrawn from the base of the stack by the suction disc 7 seen in Figures 2*c* and 2*d* which is mounted on the end of the piston rod 8 of a pneumatic cylinder (not shown). As the suction disc 7 and shell are descending, an arm 9, attached to the piston rod 8, situated below the suction disc 7 operates a shell opening lever 10 which rotates about a fixed pivot 11 to open and erect the shell as shown in Figure 2*d*. At this stage the shell is retained in position by suction and is ready to receive the product.

The mechanism described above presents an open ended hollow inner shell 1 to the product. A similar arrangement opens and erects the outer shell 3 to receive the filled inner shell 1. The product 2 may be slid into the shell 1 by any convenient means which provides rectilinear motion of a pusher. In this particular embodiment and as shown in Figures 3 and 4 a pusher 12 on the end of a piston rod of a pneumatic cylinder 13 serves this purpose the product 2 is positioned in front of the pusher 12 by a vertically reciprocable platform 14 forming part of the delivery mechanism of a prepacking machine. A suitable aperture 15 is provided in the base plate of the machine to allow the platform 14 to deliver the contents 2 to the pusher 12.

It is necessary to provide guides for the entry of the contents 2 into the inner shell 1 to prevent the contents from catching on the edges of the shell and preferably a guide is provided for each of the four edges of the mouth of the inner shell. Each consists, in this embodiment, of a flexible flat spring 16 as shown in Figure 10. Normally, the springs 16 stand erect to allow the shell to be drawn vertically downwards past them. As the contents 2 are pushed towards the shell 1, the springs 16 are deflected into the mouth of the shell 1 thus providing the necessary guidance. When the contents 2 are fully inserted in the shell 1 the springs 16 regain their normal position, leaving the inner shell free to be moved sideways into the outer shell 3.

Similar guide springs 16 are fitted at the outer shell filling position, to allow easy entry of the inner shell into the outer shell.

At the end of its stroke, the pusher 12 of the cylinder 13 remains in its forward position to act as a side guide for the inner shell 1 while it is entering the outer shell 3.

The sliding of the inner shell 1 into the outer shell 3 is performed by a second pusher 17 on the piston rod of a pneumatic cylinder 18.

It will be seen from Figure 3 that the axis of the cylinder 18 is on the centre line of the shell opening devices under the hoppers (not shown); it is therefore not possible to use a flat, continuous plate as the pusher 17 on the end of the piston rod of the cylinder 18. A cross head 19 is therefore fitted to the piston rod of cylinder 18 which carries two side rods 20; each side rod 20 carries a part of the pusher 17. The effect is, therefore, of a flat pusher with a gap in the middle, the gap allowing the pusher 17 to pass on either side of the shell opening device.

This arrangement also allows the piston rod of a cylinder 21 carrying the suction disc 7 to operate when the pusher of the cylinder 18 is fully forward. The suction disc 7 rises ready to draw down the next inner shell 1 whilst the pusher 17 of the cylinder 18 is fully advanced. This arrangement considerably reduces the total cycle time, thus increasing the rate of production.

The complete pack is removed by a third cylinder 23 shown in Figure 3. The pusher 24 is similar to that on the cylinder 18, being divided to clear the shell opening lever for the outer shell. This construction allows a suction disc 7 on the piston rod of a cylinder 26 to rise whilst the pusher 24 of the cylinder 23 is fully forward, again reducing the cycle time. Also, the pusher 17 on the piston rod of the cylinder 18 remains forward, acting as a side guide for the complete pack during its subsequent movement towards the package orienting arrangement.

The complete packages are discharged from below the outer shell hopper in the

direction of the arrow 25. The packages are conveyed along the base plate between suitable guides and are fed to a package orienting or toppling arrangement as shown in Figure 5. At the end of the guides and adjacent to the edge of the base plate is a brush or other type of retainer 27 to prevent over-run of the package before reaching a toppling block 28. The top of the toppling block 28 is level with or slightly below the level of the base plate. As the packages are pushed along, the leading pack on the toppling block moves to an end stop 29. It is then supported by less than one half its width. The pack then topples down and over on to its side on to the next platform as shown in Figure 6. Again, it is supported by less than one half its length and so topples down and over on its end on to the base of the collator channel 32 as illustrated in Figure 7. When the pack comes to rest on the base of the channel 32 it blocks off a back pressure jet 30, which through a fluidic system, operates a pneumatic cylinder 31 to move the pack along the collator channel 32. The back pressure jet is shown in more detail in Figures 8*a* and 8*b* and when the pack moves along the collator channel 32 it then frees the back pressure jet 30 to signal the cylinder 31 to return to its original position.

By this method, packages may be collated on any desired end or side face of the pack by suitable design of the toppling block 28.

The operations of the various pneumatic cylinders are controlled by a "fluidic" circuit, using commercially available components.

The basic component of the system is a turbulence amplifier for example as illustrated schematically in Figures 9*a* and 9*b*. This consists essentially of a flow of air from a very small inlet pipe 33 across a gap into the entry of a similar small outlet pipe 34. If the air pressure at the inlet is for example at 4 inches W.G., sufficient air enters the outlet pipe 34 to produce a pressure of 1 inch W.G., in the outlet pipe. Surrounding these two small pipes is a tubular sleeve 35, into the side of which are fixed small tubes or control jets 36 directed at the main stream of air passing from the inlet tube to the outlet tube. If a small stream of air be directed from one of the side jets, the main air stream is deflected away from the outlet pipe and the air pressure in the outlet pipe falls from 1 inch W.G. to zero.

The turbulence amplifier constitutes the logic element of a "NOT" or "NOR" element of the logic circuit. Several turbulence amplifiers may be combined together to form the logic elements of a "FLIP FLOP" an "AND" element, and "NAND" element and so on. A control circuit can then be designed exactly as an equivalent electronic control circuit.

Each output of a fluidic control circuit has to control air at high pressure. In a typical system this is effected by means of a step-up relay. The change of pressure from a turbulence amplifier of 1 inch W.G. to zero is sufficient to turn on, or off, the high pressure air flow. The high pressure air is used with conventional components to operate pneumatic cylinders etc.

The principle of a small jet of air passing from an inlet tube or pipe across a gap to enter an outlet tube or pipe is used as a means of applying a signal to a turbulence amplifier. If some solid object is inserted into the gap, the air jet is interrupted and the pressure in the outlet tube falls from 1 inch W.G. to zero. This device is known as an interruptible jet.

For the packing machine of the invention, a timer is incorporated using interruptible jets which control the motions, in sequence, of all the pneumatic cylinders involved, except that of the collator. A series of interruptible jets is arranged circumferentially round a shaft driven by a pre-packer (not shown) or by an electric motor if no pre-packer is used. The shaft carries projections which act as interrupters for the interruptible jets.

Another method of supplying a control pulse or signal to a turbulence amplifier is by means of a back pressure jet. The back pressure jet 30 shown in Figure 7 has a small open recess to which air at 4 inches W.G. is fed through inlet pipe 38 and an outlet pipe 39 for example as shown in Figures 8*a* and 8*b*. If the recess 30 is open, no air will enter the outlet pipe 39 since the air escapes through the open recess; if the recess 30 is covered with a solid object such as a package as in Figure 7, then air passes through the outlet pipe 39 and provides a signal.

This type of back pressure jet is used throughout the packer to provide signals associated with a safety circuit.

All the piston rods have their length of stroke controlled by adjustable stops. Each stop is fitted with a back pressure jet and a blade attached to the respective piston rod covers the back pressure jet at the end of each stroke and so provides a signal to a turbulence amplifier to register that the piston has successfully completed its stroke. If a piston fails to complete its stroke, due to a malfunction, this actuates the safety circuit so that the normal subsequent motions of any other pistons are inhibited and the whole machine is stopped at the end of the cycle.

The "normal" starting and stopping of the packer is effected through the fluidic control circuit.

The sequence of operations illustrated with particular reference to Figure 3 may be summarised as follows:

The contents are raised on the platform 14 from a preceding work station through an opening 15 in the base plate as seen in Figure 4 level with the top of the base plate, and aligned with the cylinder 13.

The piston rod of cylinder 18, which is in its forward position from the previous cycle and the piston rod of cylinder 21, is now raised and the associated suction disc 7 comes in contact with the unopened bottom of a shell 1 and suction is applied while the piston rod of cylinder 18 returns to its inward position.

The piston rod of cylinder 21 is then lowered taking the lower inner shell with it. Before the piston rod of cylinder 21 reaches the end of its stroke, the shell opening lever 10 is brought into operation and when the piston rod of cylinder 21 reaches the end of its inward stroke, the inner shell 1 is fully opened and held in place by suction.

The piston rod of cylinder 13 now advances and moves the contents from the lifting platform 14 into the opened inner shell 1. The piston rod of cylinder 23 now moves forward to reject the completed previous package and the piston rod of cylinder 26 is now raised so that the associated suction disc 7 comes in contact with the next unopened bottom outer shell 3.

The piston rod of cylinder 23 is now retracted to its inward position and suction is applied to the suction disc 7 on the piston rod of cylinder 25 which is now lowered at the same time taking the lowest outer shell 3 with it. Before the rod reaches the end of its inward stroke, the associated shell opening lever 10 is brought into operation. When the piston rod reaches the end of its stroke the outer shell is fully opened and held in place by suction.

The vacuum is now released from the suction disc 7 associated with cylinder 21 and the piston rod of cylinder 18 moves the loaded inner shell 1 into the outer shell 3. To complete the cycle, the piston rod of cylinder 13 returns to its inward position and suction is released from the cylinder suction disc 7 associated with cylinder 26, completing the cycle. The next actuation of the cylinder 23 moves the assembled package out from underneath the outer shell hopper or magazine.

In a modified embodiment of the invention, either or both shells may be made of a rigid, preformed tubular material, such as a synthetic plastics material, in which case the hoppers will be modified to allow each shell to be fed to the appropriate suction disc. In most cases, each shell will be open at both ends. However, where desired either or both shells may have one end closed. The edges of the shells may also be shaped or cut away to allow easier access to the contents of the package or to facilitate separation of the inner and outer shells.

WHAT WE CLAIM IS:—

1. A packaging machine for producing a package comprising an inner shell containing the contents of the package and an outer shell which contains the inner shell, said machine including a first, vertical magazine containing inner shells and a second vertical magazine containing outer shells, control means by which all the movements imparted to the individual parts of the package and to the assembled package are controlled, means for extracting the inner and outer shells from the lower end of each magazine, means for feeding the contents of the package into the inner shell, means for moving the inner shell and contents into the outer shell and means for conveying the assembled package to a further package handling station.

2. A packaging machine according to claim 1, wherein all the movements imparted to the individual parts of the package and the assembled package by the control means are effected by means operating rectilinearly.

3. A packaging machine according to claim 1 or claim 2 wherein the movements imparted to the individual parts of the package and to the assembled package by the control means are effected by fluid operated means controlled by a logic circuit.

4. A packaging machine according to any one of claims 1 to 3 wherein each magazine is provided adjacent its outlet with means to partially open a shell still in the magazine and means are associated with each magazine to erect each shell as it is withdrawn.

5. A packaging machine according to claim 4 wherein the means for partially opening the shell comprise a deflector member and spring means and the associated shell erecting means comprises a shell-opening lever actuated by means associated with a vacuum member which withdraws each shell from its magazine.

6. A packaging machine according to any one of claims 1 to 5 wherein flexible guide means are associated with an open end of each erected shell which guide the part of the package being inserted therein into the respective shell.

7. A packaging machine according to any one of claims 1 to 6 wherein each vertical movement of the inner and outer shells is provided by a reciprocating member supplied with vacuum and horizontal movements are provided by a plurality of reciprocable pusher members.

8. A packaging machine according to claim 7 wherein the pusher members are divided to permit reciprocation of said pusher members past the vacuum member when the vacuum member is in its extended condition.

9. A packaging machine according to any one of the preceding claims and including a package orienting means comprising a pair of inclined surfaces, the first said surface being arranged to tilt a package about a horizontal axis parallel to the direction in which each package is conveyed from the outer shell filling point and the second inclined surface being arranged below said first surface and inclined in a direction which causes a package leaving the first surface to rotate about a horizontal axis at right angles to the first mentioned horizontal axis.

10. A packaging machine according to any one of the preceding claims wherein the movement of the package through the machine actuates the control means.

11. A packaging machine according to claim 3 wherein the logic circuit is a fluid logic circuit.

12. A packaging machine according to claim 11 wherein the operation of the machine is controlled by a fluid logic circuit actuating fluid operated members, said circuit including at least one turbulence amplifier having a plurality of control jets and means to cause the fluid circuit to apply control signals to the control jets of the or each turbulence amplifier, the control signals being produced by selective obstruction of said control jets.

13. A packaging machine substantially as hereinbefore described with reference to the accompanying drawings.

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1340581 COMPLETE SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

FIG.I.

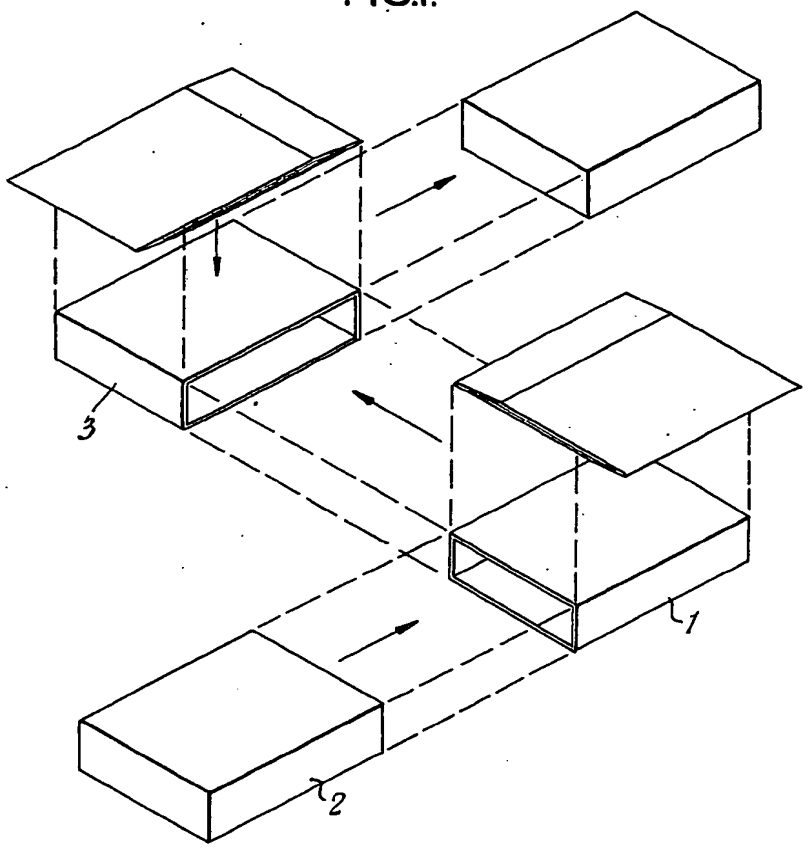


FIG.2.

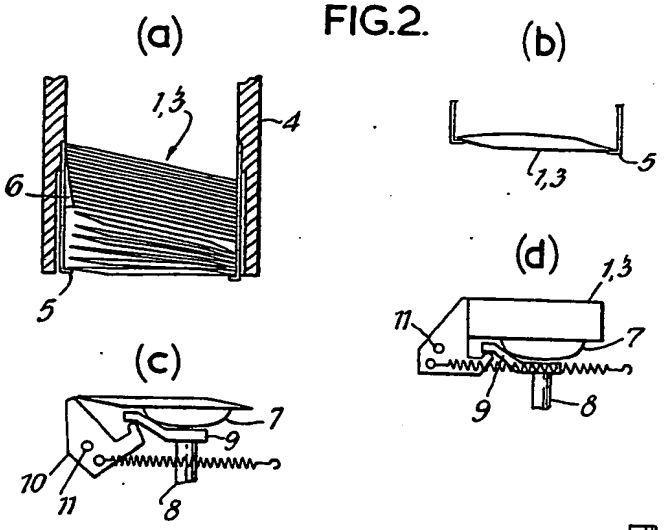


FIG.3.

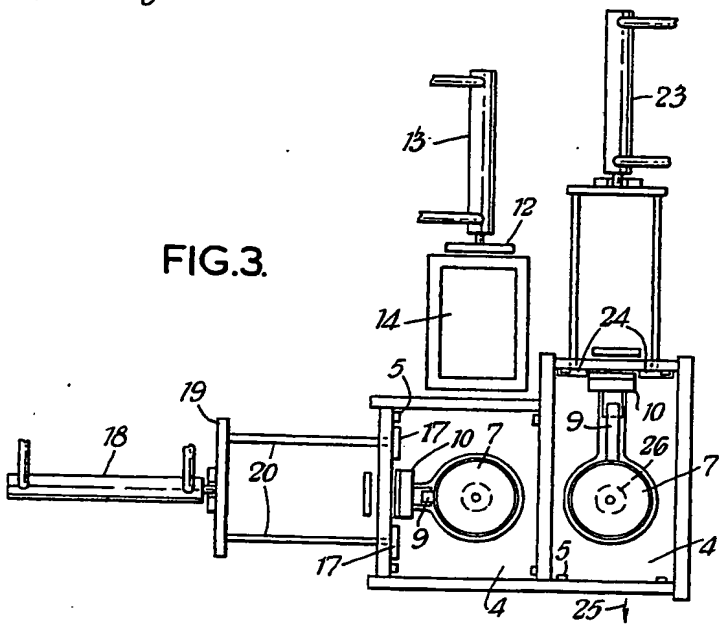


FIG.4.

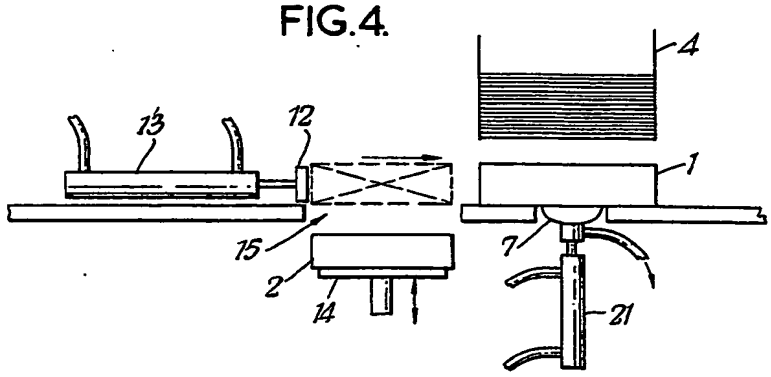


FIG.5.

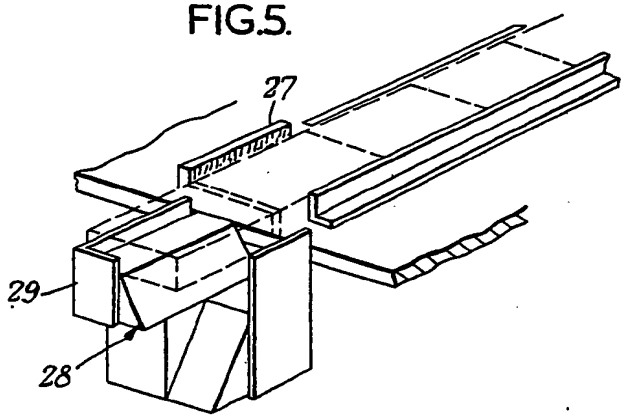


FIG.6.

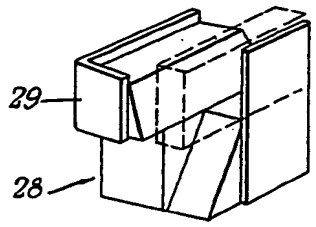


FIG.7.

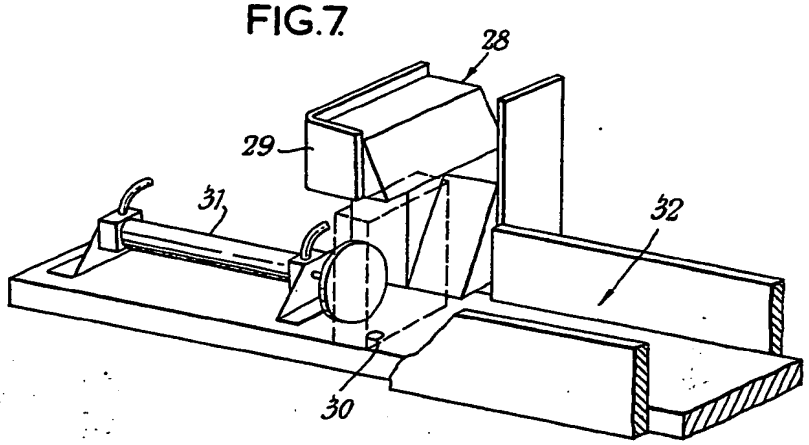


FIG.8a.

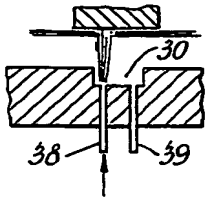
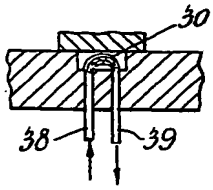


FIG.8b.



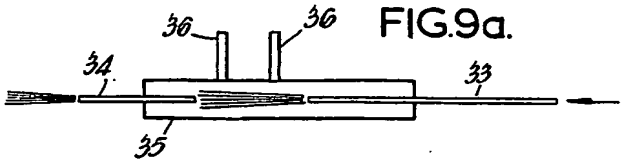


FIG.9a.

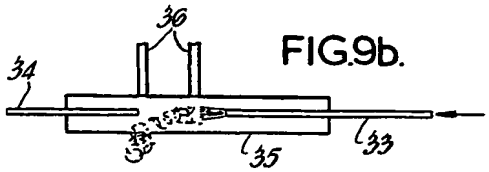


FIG.9b.

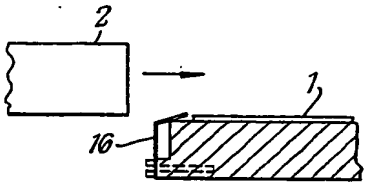


FIG.10.